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[title] **The Cessation of the Synergistic Factor of Economic Growth and Financial Crises.**

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Liudmyla Vozna

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1. Introduction

The term "synergy" is so popular in the modern social and economic sciences that sometimes its usage is absolutely improper[1]. I do not want to overuse this serious term, however to understand better some social and economic phenomena (order and disorder, equilibrium and evolution) it is necessary to apply the general laws characterizing complex dynamic systems.

Synergistic effect is an effect arising as a result of interaction between two or more elements (of a system) that produces an effect greater than the sum of their individual effects. The synergistic factor of economic growth I interpret here as such an increase of openness and, thus, interaction among economic system components (sectors, regions), which, on the one hand, leads to economic growth, and, on the other hand, is followed by the reduction of differences between these components in prices, wage rates, profit rates, productivity and so on.

But what happens if such a synergistic convergence reaches the full levelling of the mentioned indicators? Is it really perfect for the state of the economy? This article attempts to reveal the instability of this homogeneous state if it characterizes the complex dynamic economic system. One of the proofs of this thesis is a statistic correlation between minimal profit rates variation and the stock index drop. In the article, some theoretical explanations of this correlation are also proposed.

[1] First of all, I mean the situation in Russia and Ukraine.

2. The synergistic factor of economic growth: Examples from economic theory

Actually, one of the first economists whose theory dealt with an example of the synergistic effect in economy, though he did not use this term and lived long before the emergence of synergetics as a school of thought, was Adam Smith. His idea about the ability of people to exchange goods and the division of labour conception are in beautiful agreement with the synergistic principle. We can regard Smith's theory of absolute advantage, David Ricardo's theory of comparative advantage and other conceptions of international trade and regional specialization from a similar point of view.

The obvious example of the synergistic factor of economic growth is the growth caused by inter-regional economic integration. In particular, territorial integration means a reduction of different inter-regional barriers, which should facilitate the spatial mobility of resources. This, in turn, promotes more efficient exploitation of resources and, thus, the increase of an integrated area output. Within the neoclassical framework, the long-term result of inter-regional integration is depicted as a shift of the inter-regional production possibility frontier from its initial position PPF1 to the new position PPF2 (Figure 1). At the same time, the curve PPF1 is concave and describes production possibility in the two-sector model, while the curve PPF2 is more linear and describes inter-regional production possibility in the one-sector neoclassical model of regional factor allocation.[2]

In the one-sector regional model the two regions are assumed to produce different products with identical production functions (two regions have the same technological basis), and the inter-regional production possibility frontier is a straight line (the shape of PPF2 in Figure 1). The slope of the production possibility frontier here represents the marginal rate of transformation between the two regions' outputs. The straight shape of this curve implies that from the perspective of production, the output of each region can be regarded as a perfect substitute for the output of the other region: the marginal rate of increase in output of the expanding region will be exactly equal to the marginal rate of output reduction of the contracting region (*McCann, 2001/2011, p. 213*).

In the two-sector model of inter-regional factor allocation, the two regions are assumed to produce different products with different production functions (each region has a different technological basis). For example, one region's production (region A) can be capital-intensive and the other region's production (region B) can be labour-intensive. This implies that the marginal rate of transformation of production between the two regions is constantly changing according to the level of output in each region (*McCann, 2001/2011, p. 217*). That is why in the

[2] This example is taken from a book: McCann, Ph. 2001/2011. *Urban and Regional Economics*, Oxford University Press.

two-sector model the inter-regional production possibility frontier is concave (the shape of PPF1 in Figure 1).

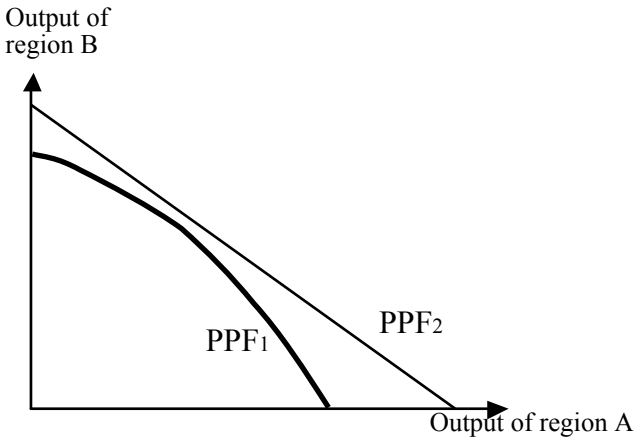

Figure 1. Production possibility frontier adjustment from a two-sector to a one-sector inter-regional model

As McCann notes, most analyses of inter-regional economic integration assume that in the long run, the one-sector model of inter-regional factor flows will be the primary mode of regional factor reallocation, and will dominate any two-sector adjustments (*McCann, 2001/2011, p. 220*). In other words, the regional economic integration is characterized by a tendency towards regions with similar production functions and similar capital/labour ratios, in which regional rates of return to capital will converge, as will regional wage rates.

Figure 1, which reflects the neoclassical conclusion about inter-regional economic integration tendency, is consistent with the general definition of the synergistic effect of economic growth, because here we deal both with the gross output increase caused by integration and with the levelling of indexes characterizing the economic activity of different regions. However, we can suppose that absolute levelling of these indexes and thus the achievement of inter-regional homogeneity can deactivate the synergistic factor of economic growth from integration.

Analogically we can look at a process of production and explain (at least partially) the origin of the surplus value as a result of the synergistic effect caused by a combination (cooperation) of different resources. From this point of view, the neoclassical law of diminishing returns can be interpreted as a tendency (law) of diminishing synergy and growing entropy.

3. Market equilibrium and price dispersion

We can apply the same synergistic idea to the analysis of economic growth as a result of synergistic interaction between demand and supply. This can be demonstrated with the help

of supply and demand curves, but for this we must use a fundamentally different-from-mainstream approach to the treatment of market equilibrium.

Traditionally, in modern economics the market equilibrium between supply and demand is represented by corresponding curves. The demand curve is the graph depicting the inverse relationship between the price of a certain commodity and the amount of it that consumers are willing and able to purchase at that given price. Analogically the supply curve represents the direct relationship, which must exist in competitive markets, between the price of a certain commodity and the amount of it that sellers are willing and able to offer. The point of intersection of these curves defines the equilibrium price (the price at which sellers together are willing to sell the same amount as buyers together are willing to buy) and the equilibrium quantity (the amount of that good or service that will be produced and bought without surplus/excess supply or shortage/excess demand) of that market.

This approach to the estimation of market equilibrium originates from neoclassical conceptions, especially from the theory of Alfred Marshall, which connected slopes of demand and supply curves with the law of diminishing marginal utility and the law of increasing marginal costs, respectively. Despite its popularity in modern economics, opponents of neoclassical economics have criticized such a definition of market equilibrium, first of all for the exaggerated role of rationalism in the attempt to explain economic behaviour and a simplification of economic reality.

Piero Sraffa, in his article "The Laws of Returns under Competitive Conditions" (*Sraffa, 1926, p. 535*), wrote:

"A striking feature of the present position of economic science is the almost unanimous agreement at which economists have arrived regarding the theory of competitive value, which is inspired by the fundamental symmetry existing between the forces of demand and those of supply, and is based upon the assumption that the essential causes determining the price of particular commodities may be simplified and grouped together so as to be represented by a pair of intersecting curves of collective demand and supply. This state of things is in such marked contrast with the controversies on the theory of value by which political economy was characterized during the past century, that it might almost be thought that from these clashes of thought the spark of' an ultimate truth had at length been struck."

When two parties dispute, the truth encompasses both. Like the neoclassical tradition I would like to use curves of demand and supply. But in contrast, here the market equilibrium is regarded not as a dead point of equilibrium but as a price dispersion of a definite type.

In my opinion, the curve of demand describes not only the dependence where a definite quantity of demand corresponds to the single price. It is evident that a consumer agrees to buy a certain commodity on the level "q1" at the price not exceeding the level "p1". Therefore we can suppose that a score "p1", corresponding to "q1" in Figure 2, is the limit of a certain price set, while the demand graph represents the upper frontier of the cloud of consumers' price preferences. That is, if a demand curve as a function may be defined by a formula:

$$D = Fd(p),$$

the cloud of consumers' price preferences may be defined as an antiderivative of the demand function:

$$Qd = \int Fd(p)dp.$$

We may apply an analogical principle in relation to the supply curve. We can suppose that the sphere of sellers' price preferences, including the supply curve, also contains some space over it. So we may regard the supply curve as a bottom frontier of the cloud of sellers' price preferences and define this by a formula:

$$Qs = \int Fs(p)dp.$$

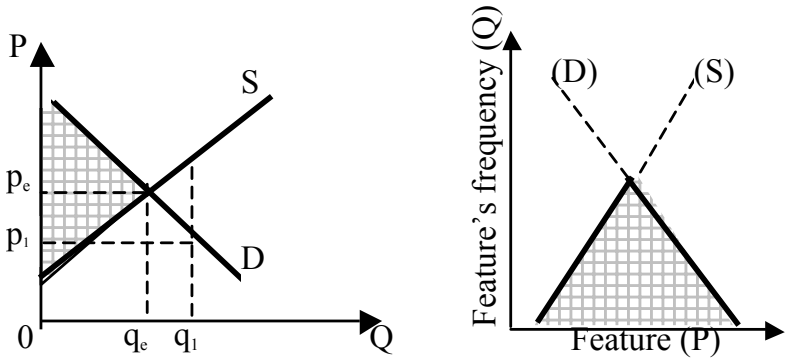

Fig. 2. The market equilibrium and price dispersion

The intersection of these two clouds of price preferences reflects not only the equilibrium price point as supply and demand curves do, but also the price multitude (this variation is marked with hatching in Figure 2). Here the demand curve describes the upper frontier of buyers' price preferences, and the supply curve describes the lower frontier of sellers' price preferences. So we deal with price dispersion where the equilibrium price "pe" reflects the most frequent (modal) price level (Figure 2). The ideal situation may be depicted by normal Gaussian distribution. But the more elastic position of demand and supply curves, the less

price variation outlined by these curves. In a situation of S-D perfect elasticity and zero price distribution, we may deal with Dirac delta distribution.

Such an approach is more realistic[3] because it deals with not only (equilibrium) price, but price dispersion, which actually has a place on markets. Based on the type of price distribution, combined with the slopes of supply and demand curves, we can better understand if a certain market system is characterized as steady, equilibrium or disequilibrium, stable or unstable (fluctuating) equilibrium.

4. The synergistic factor of economic growth and the dynamics of the stock index: the possible correlation

If both demand and supply are comparatively inelastic, it means there is a weak interaction between them. In other words, it means a weak (market) synergy. At the same time, the less elastic the slope of the demand and supply curves (following the logic above), the bigger the price dispersion we observe. So by shifting the demand and supply curve to the more elastic position, we reduce the price dispersion and shift the equilibrium point in the direction of output growth.

On the macroeconomic level, we deal with the aggregate functions; however, by applying to the macroeconomic level the same idea about the connection between price dispersion and the slopes of the demand and supply curves, we can attempt to demonstrate the synergistic effect of economic growth with the help of AD-AS curves.

Figure 3.1 demonstrates the economic growth without the action of the synergistic effect, Figure 3.2 demonstrates it with such an effect: the removal of aggregate demand and supply curves in a more elastic position (if the area of the dispersion triangle is constant) leads to a reduction of price rate variation and shifts the equilibrium level of aggregate product to the right (if the shaded area in Figure 1.1 is equal to the shaded area in Figure 1.2). The minimal (ideally zero) level of such variation means the exhaustion of the synergistic effect on economic growth.

[3] In the already cited above work, Piero Sraffa also wrote: "The conclusion that the equilibrium is in general determinate does not mean that generalizing statements can be made regarding the price corresponding to that equilibrium; it may be different in the case of each undertaking, and is dependent to a great extent upon the special conditions affecting it. The only case in which it would be possible to speak of a general price would be that of a trade in which the productive organization of the different undertakings was uniform, and in which their particular markets were alike as regards the nature and attachment of the customers" (Sraffa, 1926, P. 549).

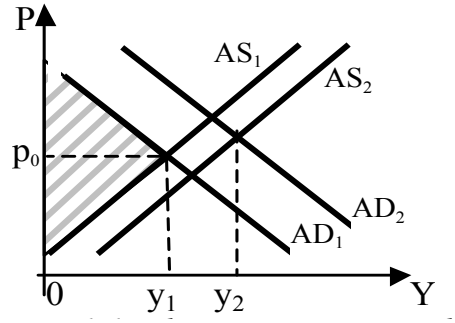

Fig. 3.1. The economic growth without synergistic effect

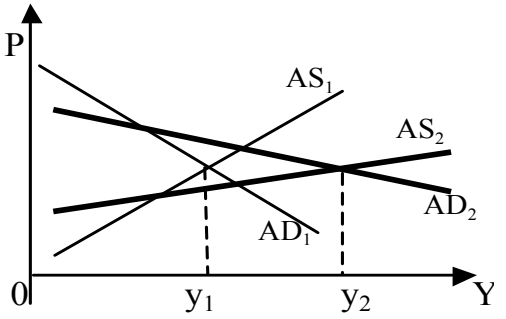

Fig. 3.2. The economic growth with the action of synergistic effect

Fig. 3. The economic growth

What happens if in the process of further AD-AS convergence the price variation becomes zero and the supply and demand curves "merge" in a way that demand cannot actually be separated from supply? On the one hand, the moment (point) when the process of further AD-AS convergence stops, the synergistic factor of macroeconomic growth also ceases to act. So by achieving a minimal price variation we reach a point of full cessation of a synergistic factor of economic growth. But, on the other hand, it also seems to look like an achievement of (or return to) subsistence farming; that is, it actually seems to look like a market crash…

Based on the synergistic idea depicted in Figure 3, I tried to check the convenient statistics on the price variation and GDP growth in the example of the USA. Due to the lack of available statistical information and my own restricted production opportunities, instead price variation data I used simple data on the variation of profit rates in the industry of the USA for the 1947-1997 period. Using these data and at the same time holding in my memory the dynamics of the Dow Jones industrial average index for the same period, unexpectedly I noticed that chronologically the lowest turning points in the profit rate variation's dynamic closely predated (or coincided with) the dropping of the stock market indexes (see appendix) (*Voznaya, 2005*).

This result is surprising as it contradicts the established views on the nature of the economic equilibrium, according to which, an intersectoral (inter-regional) levelling of profit rates, wage rates etc. is the perfect market state under the condition of the competition. But the revealed tendency provides the evidence to suggest that the perfect situation for markets can actually be disruptive for them. Does this mean that perfectness is a paradox, or should we change our idea of what perfectness is?

5. The attempt at a theoretical explanation

In favour of the assertion about a possible link between the exhaustion of the synergistic factor of economic growth and stock market crises, such theoretical theses can be applied as: (1) the cessation of innovation diffusion and absence of economic (technological) development, (2) the crisis of market institutions, (3) the maximum entropy equilibrium, (4) the trap of uncertainty and investments.

1. The exhaustion of the synergistic factor of economic growth as a cessation of innovation diffusion. The absence of economic (technological) development.

The synergistic factor of economic growth can be a result of innovation diffusion (structural and spatial). The diffusion of innovations through economic units and regions must lead to a levelling of resource productivity and, thus, to a levelling of profit rates (prices, wages). The cessation of such a levelling process (ideally, full equality) may mean the completion of innovation diffusion, that is, the exhaustion of economic growth due to this factor. For example, according to the diffusion of innovation concepts, innovation is expanding more quickly in diversified structures than in homogeneous ones. So I assume that by reaching a state of maximum uniformity (in prices and profit rate distribution), an innovation deals with the specific dead end for further diffusion. That is, such a factor of economic growth as innovation diffusion stops to act.

In its turn, the absence of innovations in a system corresponds to its stationary state. In such cases, the homogeneous system described by a homogeneous multitude of prices and profit rates is a stationary or quasi-stationary system. So a financial crisis can mean a crisis of the dynamic system institutions.

Indeed, a stock market is not only an important element of a market economy, but, first of all, it is a component of a dynamic, evolutionary economy. At this point we share the position of J. Schumpeter. In his book *The Theory of Economic Development* he affirmed the impossibility of industrial development without bank credit. According to J. Schumpeter's point of view, in an economic system characterized by the absence of development, a stock market (in the full meaning of this economic category) cannot exist (*Schumpeter, 1934/2007*). Theoretically the stock market provides the capital mobility from low to high profitable spheres and, thus, should smooth the difference in individual profit rates. From such a dynamics and development point of view, this process of capital mobility means the removal of resources from old, less effective economic spheres to new and more effective ones. If such a profit rate difference disappears, then the need for stock market activity disappears too. In other words, if the economy structure reaches a static state, the main institutions of a dynamic system can undergo a crisis.

2. The crisis of market institutions. The significant gap between price (and profit) rate levels can be the result of weak mobility of resources, goods, technologies and so on. In turn, such law mobility (or full immobility) can be provoked by high market barriers. The type of equilibrium, described by absolutely elastic position of the demand and supply curves, corresponds to a perfect resource mobility and also to a full absence of market barriers.

The reduction of barriers promotes the higher mobility and diffusion of resources (including innovations) through different sectors (regions) of the economy and a levelling of prices, productivity and profit rates. But market barriers play not only a negative but a positive role too, since the restrictions structure a system (market). Among such barriers-organizers are market institutions, including financial ones. That is, we can assume a specific feedback mechanism: the barrier reduction promotes the price dispersion decrease; the absolute price (profit rates) levelling causes the weakening of barriers, including the role of market institutions. In other words, the absence of profit rate variation must lead to a market institution crisis, including stock markets, as it implies a full absence of market barriers and, thus, a full disorder in a market system.

Moreover, it is important to note that financial resources are more mobile, if you compare them with natural, material and human ones. They also promote the mobilization of other resources. Since financial resources cannot exist themselves without financial institutions, I characterize them as institution-capacity resources. So if economic structure looks like an economy with absolute resource mobility, that is, the goal of finance use as resource-mobilization has been reached, this can be (maybe mistakably) a signal of absence of further demand for financial resources and institutions.

3. The equilibrium (state) of maximum entropy. We can conclude that a homogeneous structure is not stable also by characterizing it as a structure with a maximal level of entropy.

As applied to thermodynamics, entropy is characterized as a measure of disorder. According to statistical mechanics (L. Boltzmann's formula), the entropy S of an isolated system at thermodynamic equilibrium is defined as the natural logarithm of W, the number of distinct microscopic states available to the system given the macroscopic constraints (such as a fixed total energy E):

$$S = k \ln W;$$

here, k is the Boltzmann constant (k = 1,38 · 10−23 J/K). According to this approach, the maximal entropy characterizes the structure that consists of (a multitude of) homogeneous elements.[4]

[4] http://en.wikipedia.org/wiki/Boltzmann_constant

In fact, the given formula characterizes entropy as a probability state of the system, that is, entropy is connected with probabilities. L. Brillouin, in his book *Scientific Uncertainty and Information*, wrote: "Let us examine the evolution of some isolated system. This unstable system left on its own will be destroyed, gradually converting into more probable and stable states. At the same time both probability and entropy are growing" (*Brilloin, 1964/2006*).

From such a point of view, the type of economic equilibrium characterized by zero dispersion of prices and profit rates has a maximum level of entropy, because the price differences here (among sellers) are minimum, theoretically they are absent. That is why, in such a situation, there is a great probability that all goods are on the market for a given price p_o. Or, from another point of view, there is a great probability that every firm has a given rate of profit.

Assuming the thesis about such a type of equilibrium as maximum entropy equilibrium, we can come to the following conclusions about it (non-dispersion equilibrium, analogically to Dirac delta distribution):

1) Since entropy is a measure of disorder, the system (structure) characterized by such a type of equilibrium is absolutely not organized (not structured). It is a chaotic, not systematic, state. So it is not a long-term (with minimal time density) formation.

2) As a non-organized state, this equilibrium exists away from some economic institutions, including market ones.

3) Such a state of being absolutely chaotic and not structured cannot exist as a system. It means that after having reached the maximum level of entropy, the system dies (fails, stops to exist).

4) The entropy is linked with the transformation of energy of a high quality into a lower-quality one. The quality of energy, in turn, is characterized by its ability to do some work. If the increase of entropy means the lower capability of the system to do some work, the state of economy with maximum entropy should be characterized by minimum productivity and functionality. Such an economic formation has no energy, i.e. no movement potential (changes, development). Thus, such a market state excludes innovation processes.

4. The trap of uncertainty and investments. Maximum entropy corresponds to zero information. According to information theory, entropy is the opposite of information: the additional information about the system we deal with is a consequence of entropy reduction. So information represents negative contribution in entropy and it is equivalent to negentropy (*Brillouin, 1964/2006*).

The homogeneous structure must be characterized by zero information (information capacity). So according to the information theory, an equilibrium multitude of homogeneous elements in a chaotic state (absolute equilibrium) cannot possess information (*Melnik, 2003*). Incidentally, the perfect mobility of resources means the absence of information barriers as well.

It is important to note that on the stock markets information is one of the basic resources. That is, a situation of absence of profit rate variation corresponds to specific information vacuum or, in other words, it causes the trap of uncertainty, which "catches" investors. It is precisely such moments of absolute uncertainty that we can regard as the moments of "excessive optimism" or "excessive pessimism" that are described by business cycle theories. So, this point of economic dynamics is characterized by unstable equilibrium and means the end of one cycle and the beginning of the next.

6. Conclusion

One of the founders of synergetics, I. Prigogine, in his book *Exploring Complexity*, together with G. Nicolis, wrote that order looks like a kind of compromise between two antagonistic factors. The first factor is a non-linear process like a chemical one, which continuously and uncoordinatedly sends innovation signals in the form of fluctuations. Another factor is the process of transportation type that catches, passes and stabilizes these signals. The violation of the delicate balance between these two factors leads to qualitative changes of state. One of them is a chaotic state in which every element of a system acts independently. In another situation we have a homeostatic, frozen state, which is characterized by complete homogeneity and where all fluctuations are suppressed. So the complexity from both sides is constricted by two types of disorder (*Nicolis, Prigogine, 1989/2003*).

Actually, in this article the main attention has focused on the disorder of the second type. In other words, we have regarded the case when the transportation (unification) factor drives out the fluctuation (innovation, variation) factor. If we imagine the price distribution under a weak elasticity of supply and demand, we deal with the disordered variety, that is, with the disorder of the first type.

The schemes and conclusions proposed above are too abstract. Of course, the real economy is more complex. The complete absence of price or profit rate variation is a pure theory, and the character of demand and supply is more complex than the Figures demonstrate. But, in any case, I hope these abstractions, revealing some specific links between the real sector of

economy and the financial sector, can be useful for forecast methodology, in spite of the complex and non-linear character of such processes as financial shocks.

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Appendix

The link of variation of profit rates with general economic dynamics and stock market indices

(on example of USA)

Year	Profits after taxes (in cents) per dollar of sale, in corporation sector of industry			Linear coefficient of profit rate, %	Dow Jones industrial average index
	Durable goods industries	Non-durable goods industries	All manufacturing corporations		
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
1947	6,7	6,7	6,7	***0***	***177,6***
1948	7,1	6,8	7,0	1,9	180,0
1949	6,4	5,4	5,8	8,3	***179,5***
1950	7,7	6,5	7,1	8,5	216,3
1951	5,3	4,5	4,9	8,2	257,6
1952	4,5	4,1	4,3	4,7	270,8
1953	4,2	4,3	4,3	***1,2***	276,0
1954	4,6	4,4	4,5	2,2	334,0
1955	5,7	5,1	5,4	5,6	442,7
1956	5,2	5,3	5,3	***0,9***	493,0
1957	4,8	4,9	4,8	1,0	***475,7***
1958	3,9	4,4	4,2	5,7	491,7
1959	4,8	4,9	4,8	***1,0***	632,1
1960	4,0	4,8	4,4	9,1	***618,0***
1961	3,9	4,7	4,3	9,3	691,6
1962	4,4	4,7	4,5	***3,0***	***639,8***
1963	4,5	4,9	4,7	4,3	714,8
1964	5,1	5,4	5,2	2,5	834,1
1965	5,7	5,5	5,6	1,8	910,9
1966	5,6	5,6	5,6	***0***	***875,6***
1967	4,8	5,3	5,0	4,8	879,1
1968	4,9	5,2	5,1	***2,6***	906,0
1969	4,6	5,0	4,8	4,2	***876,7***
1970	3,5	4,5	4,0	12,5	***753,2***
1971	3,8	4,5	4,1	8,4	884,8
1972	4,2	4,4	4,3	2,3	950,7
1973	4,7	4,8	4,7	***1,1***	***923,9***
1974	4,7	6,4	5,5	15,4	***759,4***
1975	4,1	5,1	4,6	10,9	802,5
1976	5,2	5,5	5,4	2,5	974,9

1977	5,3	5,3	5,3	***0***	***894,6***
1978	5,5	5,3	5,4	1,9	***820,2***
1979	5,2	6,1	5,7	7,8	844,4
1980	4,0	5,6	4,8	16,7	891,4
1981	4,2	5,1	4,7	***9,4***	932,9
1982	2,4	4,4	3,5	28,3	***884,4***
1983	3,1	4,9	4,1	21,7	1190,3
1984	4,4	4,8	4,6	***4,3***	***1178,5***
1985	3,4	4,1	3,8	9,0	1328,2
1986	2,9	4,6	3,7	22,9	1792,8
1987	4,5	5,2	4,9	***7,0***	2276,0
1988	5,2	6,6	5,9	11,9	***2060,8***
1989	4,1	5,7	4,9	16,3	2508,9
1990	3,0	4,8	3,9	23,1	2678,9
1991	0,5	4,1	2,4	74,8	2929,3
1992	-1,7	3,1	0,8	300,0	3284,3
1993	1,8	3,7	2,8	33,8	3524,7
1994	5,3	5,5	5,4	***1,9***	3794,2
1995	5,2	6,0	5,6	7,1	4493,8
1996	5,5	6,5	6,0	8,3	5742,9
1997	5,8	6,7	6,2	7,2	7441,2

Sources: Economic Report of the President to the Congress /http://www.iatp.unibel.by/USAinfo/trade/budjet/erp.htm; Statistical Abstract of USA / Bureau of the Census, D.C. - Washington: U.S.